

We claim:

1. A method for balancing traffic across paths connecting a network to the Internet

comprising:

forming a connection between a home network and a large network which connects to a
5 plurality of networks, wherein said connection comprises a plurality of paths carrying traffic in
the form of data packets between the home network and said large network, and wherein each
path has a path load;

selecting one of said plurality of paths, wherein said plurality of paths comprises said
selected path and other paths, and wherein said selected path has a traffic load and an initial

10 overload;

measuring the amount of traffic from the home network to the large network over the
selected path;

measuring the congestion over the selected path;

measuring the available capacity over the selected path;

15 choosing the path load for each of said plurality of paths using a fractional allocation
strategy, wherein the time to generate information is minimized and the amount of traffic lost to
overloads is minimized; and

distributing a portion of the traffic from the selected path to the other paths.

2. The method for balancing traffic across paths connecting a network to the Internet

according to claim 1, wherein the fractional allocation strategy comprises:

- (a) associating the paths with a counter i , wherein the counter is a number equal to one (1) and there are a total of j paths;
- (b) calculating the total initial selected path overload;
- 5 (c) calculating the selected path load, wherein the load is equal to the initial selected path overload less the sum of the low capacity boundary for i path(s);
- (d) calculating the portion of the traffic on the selected path to be distributed using a bi-sectional search strategy;
- (e) distributing a portion of the traffic on the selected path to the other paths; and
- 10 (f) stopping if there are no more paths ($i = j$), otherwise increasing the numerical value of the counter by one (1) and go to step (c).

3. The method for balancing traffic across paths connecting a network to the Internet according to claim 1, wherein the portion of the traffic is distributed to the other paths using the equation

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$$x_i = l_i + \frac{h_i - l_i}{\sum_{i=1}^P (h_i - l_i)} x \left(x_0(0) - \sum_{i=1}^P l_i \right), \quad (1)$$

wherein x_i is the path load, l_i is low capacity boundary, h_i is high capacity boundary, P is the total number of paths and $x_0(0)$ is the initial overload on the selected path.

4. The method for balancing traffic across paths connecting a network to the Internet according to claim 2, wherein the portion of the traffic is distributed to the other paths using the equation

$$x_i = l_i + \frac{h_i - l_i}{\sum_{i=1}^P (h_i - l_i)} x \left(x_0(0) - \sum_{i=1}^P l_i \right), \quad (1)$$

5 wherein x_i is the path load, l_i is low capacity boundary, h_i is high capacity boundary, P is the total number of paths and $x_0(0)$ is the initial overload on the selected path.

5. The method for balancing traffic across paths connecting a network to the Internet according to claim 2, wherein the bi-sectional search strategy uses a multidimensional iterative bisection search algorithm.

10 6. The method for balancing traffic across paths connecting a network to the Internet according to claim 1, wherein the cost is measured using the equation $C = \sum_{t=1}^T \sum_{i=0}^P [x_i(t) - c_i(t)]^+$, and wherein C is the cost, T is the time period over which the feasible solution is obtained, P is the number of paths between the home network and the large network, x is path load and c is the capacity of the path at time t .

15 7. The method for balancing traffic across paths connecting a network to the Internet according to claim 1, wherein the amount of traffic from the home network to the large network over the selected path is measured using flow level measurements or Simple Network

Management Protocol (SNMP).

8. The method for balancing traffic across paths connecting a network to the Internet according to claim 1, wherein the congestion over the selected path is measured using active probes, or passive measurements of traffic details.

5 9. The method for balancing traffic across paths connecting a network to the Internet according to claim 1, wherein the congestion over the selected path is measured using Transmission Control Protocol (TCP) Synchronize/Acknowledgement (SYN/ACK) response time.

10. The method for balancing traffic across paths connecting a network to the Internet
10 according to claim 1, wherein the congestion over the selected path is measured using Round Trip Time (RTT), and loss measurements.

11. The method for balancing traffic across paths connecting a network to the Internet according to claim 1, wherein the available capacity over the selected path is measured using flow level measurements, Simple Network Management Protocol (SNMP) link measurements,
15 Round Trip Time (RTT), loss measurements, active probes, or Transmission Control Protocol (TCP) Synchronize/Acknowledgement (SYN/ACK) response time.